KDI Journal of Economic Policy 2021, 43(1):53–80
http://dx.doi.org/10.23895/kdijep.2021.43.1.53

Trade Liberalization and Manufacturing Productivity Changes in Korea during the Past Three Decades†

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The main objective of this study is to determine whether there have been TFP increases in the Korean manufacturing sector due to trade liberalization since the 1990s. Based on the methodology proposed by Pavcnik (2002), which focuses on the channel through which trade liberalization measures enhance overall industrial productivity by triggering the exit of low-productivity firms, this study tests the following two hypotheses: first, the TFP increase in the Korean tradable industry is not higher than that in the non-tradable industry, and second, plants with lower TFP levels did not exit from the tradable industry. Through the rejection of these two hypotheses, it is possible to infer indirectly the effect of trade liberalization on firm productivity rates in Korea since the 1990s. First, this analysis reveals that since the 1990s, the TFP of the tradable sector compared to the non-tradable sector presented a statistically meaningful increase only in the 2000s, when China joined the WTO and trade increased sharply between Korea and China. Secondly, TFP growth in the tradable sector was positively affected by exits, as it was plants with lower TFP levels that ceased to exist.

Key Word: Trade Liberalization, Productivity, Exit
JEL Code: F13, F14, O3

I. Introduction

Policies related to the growth of the manufacturing industry are diverse, including industrial support policies such as R&D policies, fair competition policies, and financial support policies. Considering the role that exports have played in the development of the Korean manufacturing industry, among the various policies that affect the growth of the manufacturing industry, the importance of the foreign

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* Received: 2020. 10. 7
* Referee Process Started: 2020. 10. 12
* Referee Reports Completed: 2020. 11. 24
† This paper is based on Yeongkwan Song, 2019, "Trade Liberalization and Manufacturing Productivity Changes in Korea over the Three Decades," in Yeongkwan Song, Taeho Lee and Kwansoo Kim, *Transformation of Korean Foreign Economic Policy for Innovation Growth: Manufacturing, Agriculture, and Agro-food Industry*, Chapter 2, Research Monograph 2019-05, Korea Development Institute *(in Korean)*. I appreciate valuable comments of two anonymous referees. All remaining errors are my own.

economic policy that determines the degree of trade liberalization with other countries cannot be overlooked in the growth of the manufacturing industry.

Import barriers such as tariffs, which are the main tools in foreign economic policies, have a great influence on the domestic market competition environment in terms of both the 'economy of scale' and 'strengthening market competition'. As Melitz (2003) pointed out, the expansion of export opportunities due to trade liberalization creates a favorable environment for export companies with high productivity, whereas the expansion of imports due to the opening of the domestic market creates a more unfavorable condition for domestic marginalized companies, leading to corporate restructuring and the exit of low-productivity companies.

The entry and exit of firms is the process of creative destruction, which Schumpeter noted and which is the driving force of innovation. The exit of low-productivity firms is the key to restructuring, and this restructuring has the effect of increasing the overall productivity of the industry; if the exit is not smooth, the entry of new firms may not be smooth. Han (2003) empirically analyzed the relationship between the creative destruction process of entry and exit and the increase in the total factor productivity (TFP) of industries using data for each business entity in Korea from 1990 to 1998. He found that Korea's entry and exit of businesses is more active than in other countries and that the factors of entry and exit account for approximately 45-65% of the increase in the TFP from 1990 to 1998 in Korea's manufacturing industry. In other words, his research shows that the process of entry and exit played a major role in improving the efficiency of the Korean manufacturing industry in the past.

This study will analyze the relationship between Korea's trade liberalization policy and productivity in the Korean manufacturing industry. Since the 1980s, Korea has implemented foreign economic policies for trade liberalization several times. As the WTO Uruguay Round in the 1980s and 1990s progressed, tariffs in Korea fell sharply through the first (1984-88) and second (1989-94) Advance Notice System for tariff rate reduction. In addition, diplomatic relations between Korea and China in 1992 functioned as an important foreign economic policy that greatly influenced trade liberalization between the two countries. Since the 2000s, Korea's tariff cuts have been the result of FTAs.[1] In the 2010s, with the Korea-EU FTA in 2011, the Korea-US FTA in 2012, and the Korea-China FTA in 2015, Korea signed FTAs with a number of major trading partners, excluding Japan. An empirical analysis of how Korea's trade liberalization policy since the 1990s has affected productivity in the Korean manufacturing industry can have meaningful policy implications for future foreign economic policies.

Extensive empirical studies exist on the impact of trade liberalization on productivity.[2] From the standpoint of domestic companies, trade liberalization can be divided into four categories in terms of final goods and intermediate goods, and exports and imports. The first is the expansion of export opportunities in the final

[1]The Korea-Chile FTA took effect in 2004, and the Korea-Singapore FTA and the Korea-EFTA FTA came into effect in 2006. In 2007, the Korea-ASEAN FTA in goods went into effect, and in 2010, the Korea-India FTA went into effect.

[2]See, for example, Tybout *et al.* (1991) and Pavcnik (2002) for Chile; Iscan (1998) and Tybout and Westbrook (1995) for Mexico; Muendler (2002) and Hay (2001) for Brazil; Krishna and Mitra (1998) and Topalova and Khandelwal (2011) for India; Harrison (1994; 1996) for the Ivory Coast.

goods market, the second is the expansion of import competition in the final goods market, the third is the improvement of access to imported intermediate goods, and the fourth is competition with the imported intermediate goods. Shu and Steinwender (2018) reviewed empirical studies on the impact of trade liberalization on corporate innovation through the lens of these four categories. They found, first of all, that there were various heterogeneities in the impact of trade liberalization on productivity and innovation. With regard to expanding export opportunities and improving access to intermediate goods for import, the majority of empirical results showed that this improves the productivity and innovation of enterprises. However, there were many differences in the effects of import competition. Most existing studies that have empirically analyzed the effects of tariff reductions in developing countries have found a positive effect on domestic productivity. Meanwhile, both positive and negative effects of reduced tariffs were found to coexist in the case of developed countries, and there have been few empirical studies of the competition for import intermediate goods.[3]

In the Korean case, empirical studies that analyzed the effect of mitigating the import barrier include those by Choi and Tcha (2005), Han (2007), and Lee (2007). Choi and Tcha (2005) empirically investigated the negative impact of Chinese imports, that is, the increase in the exit of existing SMEs and the impediment of entry of new SMEs in industries with a high Chinese import penetration rate. They also pointed out that the capital intensity of surviving SMEs did not increase, meaning that the increase in imports from China hindered capital accumulation by SMEs. Han (2007) also concluded that imports from China, in particular, were related to the decline in the share of employment in the domestic manufacturing industry and that they negatively affected the value-added and the share of employment in labor-intensive industries. Lee (2007) analyzed how changes in import tariffs measured by the effective tariff rate had an effect on the total factor productivity of individual manufacturing businesses. Through a regression analysis of the entire manufacturing industry, however, he empirically showed that the lower the import tariff barrier is, the higher the total factor productivity of individual businesses becomes.

This study shows differences in the methodology and analytical period from previous studies that empirically analyzed the effects of import liberalization in Korea. It is well known that it is difficult to measure the direct causal relationship between trade liberalization and manufacturing productivity.[4] In an influential study of the effects of trade policy on productivity, Pavcnik (2002) proposed a difference-in-differences methodology to measure the relationship between trade liberalization and manufacturing industry productivity in order to overcome this direct measurement problem. Unlike previous studies of the effects of import liberalization in Korea, the present study adopts the difference-in-differences methodology proposed by Pavcnik (2002) and divides the entire Korean manufacturing industry into the tradable sector, including export-led, import-competing and intra-trade

[3]Kee (2015) seems to be the only study that is relevant to the impact of foreign input competition in that his study showed that domestic firms in the Bangladeshi garment sector enjoy positive spillovers from sharing the same local suppliers with foreign-owned firms.

[4]There have been several discussions of the limitations of the methodologies of existing empirical studies on the effects of import liberalization. For discussions on this, see Rodrik (1992), Rodríguez and Rodrik (2000), Goldberg and Pavcnik (2016), and Irwin (2019).

industries, and the non-tradable sector based on the share of imports and exports. Based on this, in order to examine the relationship between trade liberalization and changes in the productivity of manufacturing sectors in Korea, the changes in TFP in each tradable sector compared to those of the non-tradable sector are estimated through a regression analysis. This study also analyzes three periods since the 1990s, excluding the period of the Korean financial crisis in the 1990s and the global financial crisis in 2007. These are 1991-97, 2002-07, and 2012-17.

This study focuses on how trade liberalization, especially the easing of import barriers, improves productivity across industries through the exit of low-productivity firms. In order to examine the effects of the exits of low-productivity firms on productivity, the first step is to estimate the production function to estimate productivity for each manufacturing plant. After deriving the TFP for each plant based on the estimated production function, the TFP of each tradable and non-tradable industry is obtained by a weighted average based on the added value of each plant. In addition, with the methodology suggested by Melitz and Polanec (2015), the growth factors of the TFP of each tradable and non-tradable sector are decomposed into entry, survival, and exit to examine the effect of the exits on the TFP of the manufacturing sector. In the second step, a regression analysis is conducted to estimate the changes in the TFP of existing firms in the tradable sector compared to those in the non-tradable sector and to compare the TFPs of exiting and existing firms classified by trade type.

The main results of this study are as follows. First, it was found that plants with low TFP levels exited in tradable and non-tradable industries, indicating that exits had a positive effect on improving productivity in the manufacturing industry. This is similar to the findings of Han (2003), showing that exits contributed to the increase in productivity in the Korean manufacturing industry. Second, the increase in the TFP in the tradable industry compared to the non-tradable industry after the 1990s was statistically significant only in the second period of the 2000s. These findings are robust to several econometric specifications.

The second result may be surprising because it was the first period of the 1990s when tariff cuts were considerable. However, the overall increase in exports and imports in the 2000s was nearly twice that of the 1990s. If tariff cuts do not lead to increased trade volumes, the impact on firm productivity would be limited, as the influence of trade liberalization on the productivity rates of firms differs depending on how a company responds to the business environmental changes that trade liberalization brings. For example, if the expansion of export opportunities due to trade liberalization only results in the expansion of production by low-productivity companies without efforts to improve TFP, the productivity of the related export industry may decrease. The second result of this study indicates that firms in tradable industries made greater efforts to improve their productivity rates in response to the business environmental changes that trade liberalization brought in the 2000s than in the 1990s and 2010s.

The remainder of this paper is organized as follows. In Section 2, both of the estimation methods for the productivity and regression modeling strategies are presented. Section 3 provides an overview of the data used in this study. This section also provides decomposition results of the growth factors of TFP and regression results of productivity changes according to each trade type. Through this, we see

how exit, entry, and survival factors influence the productivity change of each trade type. In addition, through a regression analysis, the impacts of firm exits on productivity rates are estimated and the effects of Korea's trade liberalization on productivity since the 1990s are inferred indirectly. Finally, in Section 4, the results of this study are summarized and the limitations of this study are addressed. In addition, future research topics are presented and policy suggestions are made.

II. The Econometric Model

A. *Productivity Estimation*

TFP refers to the part of production that is not explained by the input of all measurable factors of production, unlike single-factor productivity aspects such as labor productivity and capital productivity. In general, TFP is interpreted as a technological change in economics. A widely used method to measure TFP is to use the Cobb-Douglas production function, where Y represents production, L is labor input, K is capital input, and A is defined as TFP, which is the part of production not explained as labor and capital input.

$$Y = AL^{\alpha}K^{\beta} \tag{1}$$

TFP estimation methods include a growth accounting method and a production function estimation approach. The growth accounting method is based on Solow (1956; 1957). In this approach, TFP is assumed to be the remaining part of production that is not explained by changes in L and K in equation (1). However, in order to estimate TFP in this way, limited assumptions such as a constant return to scale, perfect competition in the input market, and neutral technological changes are required.

The production function estimation method was proposed in order to solve the endogenous problem due to the possibility of the existence of a correlation between the production factor and the error term. Typical methods that use this approach include those by Olley and Pakes (1996) and Levinsohn and Petrin (2003). They attempted to control the endogenous problem using what was termed a control function approach. Olley and Pakes (1996) sought to solve the endogenous problem caused by the correlation between the unobservable TFP and production factors by means of investment. In other words, looking at TFP as a function of investment, it is possible to redefine the production function as a function of production factors such as labor, capital and investment. We can also redefine the production function as a function of observable variables. Olley and Pakes (1996) proposed to estimate the defined function first and then estimate TFP through it. However, this method can result in a left censoring problem, as there may be years in which investments are not made in the data. Levinsohn and Petrin (2003) tried to complement the method by Olley and Pakes (1996) using intermediate goods instead of investment. In other words, they sought to control the endogenous problem by defining TFP as a function of intermediate goods and capital and redefining the production function as

a function of labor, capital, and intermediate goods.

In the 'Mining and Manufacturing Survey' of the National Statistical Office in Korea, data related to the cost of production paid by companies, such as their electricity costs, are compiled. Therefore, it is easy to estimate the production function proposed by Levinsohn and Petrin (2003) using the electricity cost as a proxy variable for intermediate goods. In the present study, based on the method of Levinsohn and Petrin (2003), we estimate the TFP of manufacturing plants in Korea from 1991 to 2017 from the 'Mining and Manufacturing Survey', also using the value-added method proposed by Petrin *et al.* (2004).

As formulated by Petrin *et al.* (2004), the logarithmic expression of the Cobb-Douglas production function assumed in this study is expressed as follows:

$$y_t = \beta_0 + \beta_l l_t + \beta_k k_t + w_t + \eta_t = \beta_l l_t + \Phi_t(k_t, m_t) + n_t \tag{2}$$

where $\Phi_t(k_t, m_t) = \beta_0 + \beta_k k_t + w_t(k_t, m_t)$.

Here, y_t, l_t, k_t, and m_t are the logarithm of the value-added, labor input, capital input, and intermediate goods respectively. w_t is the amount of change in TFP that the firm can observe, while η_t is the amount of change in TFP that the firm cannot observe.

We estimate the labor and capital coefficients for each KSIC (Korea Standard Industry Code) two-digit unit based on equation (2), after which we estimate the TFP for each plant using equation (3) below, where i, j, and t represent the individual plant, industry, and corresponding period, respectively. β_{li} and β_{ki} are the labor and capital coefficients for each industry, respectively, as estimated through equation (2).

$$\ln TFP_{ijt} = y_{ijt} - \overline{\beta_{lj}} \ln L_{ijt} - \overline{\beta_{kj}} \ln K_{ijt} \tag{3}$$

B. *Productivity change by trade type*

This study focuses on the relationship between trade liberalization and productivity in Korea since the 1990s. Most existing studies on the relationship between trade liberalization and firm productivity analyzed the effect of trade liberalization on productivity through the change in productivity of firms. However, issues can arise when using this approach, as it is highly likely that productivity changes caused by changes other than trade liberalization also appear as trade liberalization effects. To overcome this problem, Pavcnik (2002) indirectly examined the impact of Chile's import liberalization on TFP in industry in Chile through a comparison of the TFP change of the traded industry sector versus the non-traded industry sector under the assumption that trade liberalization does not affect the productivity of non-traded industries.

This study examines the relationship between trade liberalization and productivity changes in Korea since the 1990s according to the methodology proposed by Pavcnik (2002) in order to test the following hypothesis. First, the TFP increase of the Korean

tradable industry is not higher than that of the non-tradable industry. Second, plants with lower TFP levels did not exit from the tradable industry. Through the rejection of these two hypotheses, the effects of trade liberalization on firm productivity rates in Korea since the 1990s can be inferred indirectly.

Considering earlier work by Pavcnik (2002), the present study estimates the following equations for each period:

$$(4)\quad \ln TFP_{it} = \alpha_0 + \alpha_1(Trade) + \alpha_2(exit * Trade) + \alpha_3(Trade * Time)_{it} + \alpha_4 Z_{it} + v_{it}$$

TFP_{it} represents the TFP of each sector in each period, and $Time$ is a year dummy vector used to measure the effect of missing macroeconomic variables. $Trade$ is the vector of the dummy variables for the export-led, import-competing, and intra-trade sectors, $exit$ is the exit dummy, and Z_{it} is the industry dummy vector.

α_3 in equation (4) represents a coefficient indicating how much the TFP of each tradable sector has changed compared to the non-tradable sector in each year. Through these values, it is possible to determine the average TFP change rate of each tradable sector compared to the non-tradable sector for each year. These are coefficients that represent 'TFP changes within plants' for each tradable sector. Their values would be positive if trade liberalization has a positive effect on the productivity of the tradable sector compared to that of the non-tradable sector. In addition, if firms with low TFPs exit, the coefficient of the corresponding exit dummy vector would be negative.

The effect of trade liberalization on firms' productivity rates is theoretically not clear both in terms of exports and imports. With regard to imports, the expansion of imports due to trade liberalization causes the prices of domestic imported goods to fall. During this process, due to trade liberalization, exits by low-productivity firms can increase, and in such a case, the exit dummy coefficient is negative. In this environment, firms belonging to import-competing industries can maintain their survival through efforts to improve productivity, and in this case, the coefficient representing the change in TFP within plants by each tradable sector compared to the non-tradable sector appears as a positive number. On the other hand, firms belonging to an import-competing sector may not make efforts to increase productivity if they perceive as negative the business outlook of this industry. In this case, the change in productivity of the import-competing industry may appear negative as compared to that of the non-tradable industry.

With regard to exports, α_3 could be both positive and negative depending on the firm's response to expanded export opportunities. In order to expand profits in the expanded export market due to trade liberalization, export companies can make efforts to increase productivity by expanding their R&D investments and introducing advanced technologies. For a firm that did so successfully, the firm's productivity would increase and the coefficient representing the change in TFP within plants by each tradable sector compared to the non-tradable sector would become positive. On the other hand, if export market expansion does not results in efforts by high-productivity export firms to improve their productivity more and instead results in an increase in the proportion of production due to export expansion by low-

productivity companies, the overall productivity of the export-led sector may decrease. If this is the case, the coefficient representing the change in TFP within plants according to each tradable sector compared to the non-tradable sector then becomes negative.

III. Empirical Results

A. *Data*

The data analyzed here consist of statistics for each plant in the National Statistical Office's 'Mining and Manufacturing Survey' from 1991 to 2017. This is a complete survey of mining and manufacturing businesses that employ ten or more employees. The target manufacturing industries in this study are those designated by the eighth standard manufacturing industry classification codes of the Korea Standard of Industry Classification (KSIC), excluding food and beverage manufacturing industries (15) and tobacco manufacturing industries (16) among the two-unit classification codes 15~37. Accordingly, this study analyzes the manufacturing industries included in KSIC 17~37.

In this study, based on the classification scheme devised of Pavcnik (2002), the import/export industry is defined as an industry with an import/export ratio of 15% or more. Therefore, an export-led industry is defined as an industry with an export ratio of 15% or more, and an import-competing industry is defined as an industry with an import ratio of 15% or more. In addition, an intra-trade industry is defined as an industry with export and import ratios of 15% or more, and the remaining industries are considered to be in the non-tradable sector, which overall has a share of exports or imports of less than 15%. In order to classify these defined industries according to the KSIC classification methodology, the 'Mining and Manufacturing Survey' is linked to the UN Comtrade export and import statistics as well as the Korea Customs Service's export and import trade statistics (2003-17). For this work, the KSIC data, International Standard Industrial Classification (ISIC), and Harmonized Commodity Description and Coding System (HS) Code linkage table were used.

This study analyses the period from 1991 to 2017 but excludes the period of the Asian financial crisis in the 1990s (1998-2001) and the period of the global financial crisis in 2007 (2008-11), when GDP rates declined significantly. Moreover, the growth rates of imports and exports were negative in 2001 and 2009. The Korean financial crisis and the global financial crisis were caused by financial factors rather than the actual sector. During these crises, it was thought that the exit and productivity changes of Korean firms would have been more influenced by macroeconomic factors other than those of trade liberalization. Accordingly, this study excludes those periods and classifies the overall period into three periods, the first being 1991-97, the second 2002-07, and the third 2012-17.

This study applies equation (2) to estimate the TFP for each plant. As the dependent variable, the value-added amount provided by the 'Mining and Manufacturing Survey' is used. Regarding the capital variable, the balance at the beginning of the year of the assets shown in the 'Mining and Manufacturing Survey'

is used, with assets defined as the sum of the valuations of buildings, machinery and transportation equipment. For the labor variable, the total number of workers in this survey is used, and the power cost is used as the input of intermediate goods.

For the TFP estimation, it is necessary to make the nominal figures in the 'Mining and Manufacturing Survey' actual figures in order to use them as panel data. To this end, inflation was adjusted by a price index, which was selected as it is considered to be the most closely related to the variable in question. For labor costs, the consumer price index announced by the National Statistical Office was applied, and in the case of capital, the deflator for construction investment and facility investment was calculated using the "total capital formation by capital goods type" provided by the Bank of Korea. Electricity and water costs were adjusted using the electricity, gas and water price indices among producer price indices provided by the Bank of Korea. The producer price index provided by the Bank of Korea was used to change the nominal value added into the representational value.

B. *Decomposition of growth factors of TFP by trade type*

The annual rate of change in the TFP of an industry can be divided into the factors of surviving firms, entrant firms, and exiting firms. In addition, the factors of surviving firms can be distinguished as factors that increase the productivity of the firm itself and factors that result from the expansion of the firm's market share. In order to analyze the effects of productivity changes due to exits, this study decomposes the annual rate of change in TFP using the method proposed by Melitz and Polanec (2015), which is based on the results of Olley and Pakes (1996). According to Olley and Pakes (1996), the indicator of industrial productivity growth defined as the weighted average can be decomposed into two parts, as follows.

$$\Phi_t = \sum_i s_{it}\phi_{it} = \overline{\phi_t} + \sum_i (s_{it} - \overline{s_t})(\phi_{it} - \overline{\phi_t}) = \overline{\phi_t} + \mathrm{cov}(s_{it}, \phi_{it}) \tag{5}$$

Here, s_{it} and ϕ_{it} correspondingly represent the market share ($\sum_i s_{it} = 1$) and TFP of plant i, while $\overline{s_t}$ and $\overline{\phi_t}$ likewise represent the simple averages of the market share and TFP of firms in the relevant industry in year t, i.e.,

$$\overline{s_t} = \frac{1}{n_t} \; and \; \overline{\phi_t} = \left(\frac{1}{n_t}\right)\sum_{i=1}\phi_{it}$$

According to Equation (5), the annual TFP change index Φ_t of the industry can be decomposed into the covariance of the market share s_{it} and TFP ϕ_{it} and the simple average of the TFP $\overline{\phi_t}$ of the industry during the year Here, the covariance part indicates the extent to which the changes in the market share and resource reallocation of firms with different productivity levels contributed to the increase in industrial productivity. In other words, when the covariance is positive, it means that production by more efficient firms has increased.

Melitz and Polanec (2015) developed the Olley and Pakes (1996) method to decompose the difference in the TFP between t and $t+1$ into the factors of

surviving firms, entrant firms, and exiting firms. By applying this method, we define s as the surviving group, x as the exiting group, and e as the entrant group, and define s_{Gt} as the G group's market share. At this point, the TFP of the G group between t and $t+k$ can be rewritten as follows:

$$
\begin{aligned}
\Phi_t &= \textstyle\sum_i s_{it}\phi_{it} = s_{st}\Phi_{st} + s_{xt}\Phi_{xt} = \Phi_{st} + s_{xt}(\Phi_{xt} - \Phi_{st}), \\
\Phi_{t+k} &= \textstyle\sum_i s_{i(t+k)}\phi_{i(t+k)} = s_{s(t+k)}\Phi_{s(t+k)} + s_{e(t+k)}\Phi_{e(t+k)} \\
&= \Phi_{s(t+k)} + s_{e(t+k)}(\Phi_{e(t+k)} - \Phi_{s(t+k)})
\end{aligned} \tag{6}
$$

Let $\Delta_k\Phi = \Phi_{t+k} - \Phi_t$; then, we have the following using equation (6):

$$
\begin{aligned}
\Delta_k\Phi &= (\Phi_{s(t+k)} - \Phi_{st}) + s_{e(t+k)}(\Phi_{e(t+k)} - \Phi_{s(t+k)}) + s_{xt}(\Phi_{st} - \Phi_{xt}) \\
&= \Delta_k\overline{\phi_s} + \Delta_k \operatorname{cov}_s + s_{e(t+k)}(\Phi_{e(t+k)} - \Phi_{s(t+k)}) + s_{xt}(\Phi_{st} - \Phi_{xt})
\end{aligned} \tag{7}
$$

The first line in Equation (7) decomposes the TFP change into the factors of surviving firms, entrant firms, and exiting firms. The second line is the decomposition of the survival firm factor into a simple average part and a covariance part according to Olley and Pakes (1996). The results of decomposing the annual rate of change in the TFP for each trade type according to Equation (7) are shown in Tables 1~3.

Looking at the characteristics of the first period through Table 1, the trend of the TFP increase was clear in the manufacturing industry as a whole, and TFP increased in all industries by trade type. In particular, the increases in TFP in export-led industries and import-competing industries were large. In the intra-trade industry, the increase in TFP was the smallest. When the factors of the productivity increase

TABLE 1— DECOMPOSITION OF TFP CHANGES BY TRADE TYPE (FIRST PERIOD)

	Year	Survival	Entry	Exit	All
All manufacturing	1991	0.000	0.000	0.000	0.000
	1992	0.116	-0.025	0.042	0.132
	1993	0.155	-0.067	0.076	0.164
	1994	0.287	-0.103	0.102	0.286
	1995	0.396	-0.131	0.133	0.398
	1996	0.336	-0.123	0.160	0.373
	1997	0.498	-0.114	0.183	0.566
Export-led	1991	0.000	0.000	0.000	0.000
	1992	0.145	-0.027	0.044	0.162
	1993	0.198	-0.028	0.072	0.242
	1994	0.235	-0.037	0.079	0.277
	1995	0.312	-0.004	0.105	0.413
	1996	0.399	-0.030	0.122	0.491
	1997	0.560	-0.014	0.123	0.669

TABLE 1— DECOMPOSITION OF TFP CHANGES BY TRADE TYPE (FIRST PERIOD) (CONT'D)

	Year	Survival	Entry	Exit	All
Import-competing	1991	0.000	0.000	0.000	0.000
	1992	0.178	-0.025	0.062	0.215
	1993	0.226	-0.061	0.079	0.244
	1994	0.306	-0.082	0.102	0.326
	1995	0.299	-0.097	0.138	0.340
	1996	0.466	-0.104	0.134	0.496
	1997	0.556	-0.115	0.149	0.590
Intra-trade	1991	0.000	0.000	0.000	0.000
	1992	0.118	-0.081	0.072	0.109
	1993	0.117	-0.143	0.126	0.100
	1994	0.276	-0.184	0.160	0.253
	1995	0.398	-0.217	0.191	0.372
	1996	0.233	-0.209	0.226	0.250
	1997	0.436	-0.195	0.251	0.492
Non-tradable	1991	0.000	0.000	0.000	0.000
	1992	0.033	0.051	-0.005	0.079
	1993	0.221	-0.028	0.010	0.203
	1994	0.383	-0.087	0.016	0.312
	1995	0.393	-0.107	0.035	0.322
	1996	0.614	-0.134	0.043	0.523
	1997	0.623	-0.108	0.053	0.568

were decomposed, the survival factor had the greatest positive effect on the TFP increase of the entire manufacturing industry and all types of trade. The exit factor also had a positive effect on the increase in TFP in all industries by trade type except for non-tradable industries in 1992. The positive effect of exits was strong in the intra-trade industries and smallest in the non-tradable industries, which may be interpreted as an effect of trade liberalization. The productivity of new entrants had a negative impact on the TFP of all trade types. However, considering that the increase in TFP of surviving companies is large, this indicates that the initial TFPs of newly entering businesses are low compared to those of incumbent firms, but their TFPs increase as business activities are carried out, and businesses that do not increase their TFP are expelled.

Table 2 shows the characteristics of the second period. As in the first period, the overall manufacturing industry and all industries by trade type showed an increase in TFP, but the increase decreased significantly compared to that in the first period. In particular, during the second period, the TFP increase in export-led industries was approximately 25%, and the TFPs in import-competing industries, intra-trade industries, and non-tradable industries were close to 13%. Examining the factors that increase productivity, as in the first period, survival factors have the greatest positive effect on the TFP increase in all industries by trade type. The exit factor also had a positive effect on the TFP increase in all types of trade. The positive effect of exits was particularly strong in the import-competing industries and intra-trade

TABLE 2— DECOMPOSITION OF TFP CHANGES BY TRADE TYPE (SECOND PERIOD)

	Year	Survival	Entry	Exit	All
All manufacturing	2002	0.000	0.000	0.000	0.000
	2003	-0.011	-0.029	0.036	-0.003
	2004	0.100	-0.055	0.061	0.160
	2005	0.132	-0.083	0.084	0.133
	2006	0.150	-0.122	0.105	0.133
	2007	0.185	-0.153	0.131	0.162
Export-led	2002	0.000	0.000	0.000	0.000
	2003	0.026	-0.054	0.049	0.021
	2004	0.082	-0.085	0.072	0.068
	2005	0.040	-0.067	0.098	0.071
	2006	0.081	-0.105	0.115	0.091
	2007	0.222	-0.111	0.135	0.245
Import-competing	2002	0.000	0.000	0.000	0.000
	2003	-0.015	-0.051	0.040	-0.025
	2004	-0.038	-0.074	0.077	-0.035
	2005	0.120	-0.125	0.092	0.086
	2006	0.150	-0.146	0.090	0.095
	2007	0.211	-0.194	0.110	0.128
Intra-trade	2002	0.000	0.000	0.000	0.000
	2003	-0.021	-0.047	0.051	-0.017
	2004	0.121	-0.079	0.087	0.129
	2005	0.169	-0.117	0.120	0.173
	2006	0.178	-0.170	0.149	0.157
	2007	0.145	-0.206	0.189	0.129
Non-tradable	2002	0.000	0.000	0.000	0.000
	2003	-0.029	0.003	0.040	0.014
	2004	0.073	-0.031	0.048	0.090
	2005	0.074	-0.060	0.073	0.086
	2006	0.124	-0.069	0.092	0.146
	2007	0.155	-0.078	0.052	0.129

industries, which were heavily influenced by imports, and was smallest in non-tradable industries. This can be interpreted as an effect of trade liberalization, similar to that in the first period. Like the first period, the productivity of newly entering companies negatively affected the TFP of all types of trade. In the second period, as in the first period, the initial TFP of newly entered firms was low, but TFP increased as business activities were carried out.

Unlike the previous period, the trend of increasing and decreasing TFPs in industries by trade type is mixed in the third period, as indicated in Table 3. TFP increased in export-import and non-tradable industries but decreased in export-led industries and import-competing industries. In particular, in export-led industries, the TFP decline was close to 50%. Looking at the factors that increase productivity,

TABLE 3— DECOMPOSITION OF TFP CHANGES BY TRADE TYPE (THIRD PERIOD)

	Year	Survival	Entry	Exit	All
All manufacturing	2012	0.000	0.000	0.000	0.000
	2013	0.046	-0.050	0.032	0.027
	2014	0.029	-0.134	0.051	-0.054
	2016	0.038	-0.127	0.088	-0.002
	2017	0.126	-0.206	0.105	0.025
Export-led	2012	0.000	0.000	0.000	0.000
	2013	0.042	-0.075	0.075	0.042
	2014	-0.049	-0.202	0.109	-0.142
	2016	-0.339	-0.208	0.156	-0.391
	2017	-0.468	-0.216	0.186	-0.498
Import-competing	2012	0.000	0.000	0.000	0.000
	2013	-0.067	-0.033	0.056	-0.045
	2014	-0.154	-0.137	0.075	-0.216
	2016	-0.120	-0.090	0.146	-0.065
	2017	-0.146	-0.134	0.153	-0.127
Intra-trade	2012	0.000	0.000	0.000	0.000
	2013	0.062	-0.051	0.011	0.021
	2014	0.112	-0.121	0.025	0.017
	2016	0.292	-0.147	0.070	0.215
	2017	0.375	-0.165	0.084	0.294
Non-tradable	2012	0.000	0.000	0.000	0.000
	2013	0.108	-0.006	0.013	0.115
	2014	0.114	-0.102	0.025	0.036
	2016	0.231	-0.054	0.067	0.244
	2017	0.180	-0.065	0.077	0.192

unlike in the previous period, the survival factors in export-led industries and import-competing industries negatively affected the increase in TFP. However, the exit factor had a positive effect on the increase in TFP in all trade types. The positive impact of exits was greater in export-led industries and import-competing industries, at 15-19%, than in import-export and non-tradable industries. During the third period, Korea signed FTAs with major trading partners such as the United States, the EU, and China, but the growth rates of exports and imports were sluggish.[5] During this period, exits still contributed to the productivity of all types of trade. However, it was found specifically that the number of surviving companies in the export-led and import-competing industries continued to decline. This may mean that only in the intra-trade industry did the innovation ecosystem of the survival of companies work smoothly and that the expansion of imports through trade liberalization helped to increase the TFP.

[5]In the third period, the annual average growth rates of exports and imports were 0.9% and -1.6%, respectively. See Table 5.

C. *Estimation results of TFP changes by trade type*

The TFP growth factor analysis mentioned above revealed that the productivity of all trade types increased during all periods subject to the analysis in this study, except for export-led industries and import-competing industries in the third period. Another finding was that exits had a positive effect on firm productivity rates. With this observation, we now estimate the following equations for each period to test the two hypotheses in this study, which are firstly that the TFP increase of the Korean tradable industry is not higher than that of the non-tradable industry, and secondly that plants with lower TFP levels did not exit from the tradable industry.

$$\begin{aligned}\ln TFP_{it} &= \alpha_0 + \alpha_{11}(ex)_{it} + \alpha_{12}(im)_{it} + \alpha_{13}(bi)_{it} + \alpha_{20}(exit)_{it} + \alpha_{21}(exit \times ex)_{it} \\ &+ \alpha_{22}(exit \times im)_{it} + \alpha_{23}(exit \times bi)_{it} + \alpha_{30}(T)_{it} + (\alpha_{31})_t(ex \times T)_{it} \\ &+ (\alpha_{32})_t(im \times T)_{it} + (\alpha_{33})_t(bi \times T)_{it} + \alpha_4 Z_{it} + v_{it}\end{aligned} \tag{8}$$

Equation (8) is a more elaborate form of equation (4). TFP_{it} represents the TFP of each sector in each period and $(T)_{it}$ is the year dummy vector used to measure the effects of the missing macroeconomic variables. ex, im, and bi are dummy variables for the export-led, import-competing, and intra-trade sectors, respectively. $(\alpha_{31})_t$, $(\alpha_{32})_t$, and $(\alpha_{33})_t$ in equation (8) are coefficients indicating how much the TFP of each tradable sector has changed compared to the non-tradable sector in each year. As noted earlier, these are coefficients that represent 'TFP changes within plants' for each tradable sector. If these values are positive, we reject the first hypothesis of this paper and conclude that trade liberalization has a positive effect on the productivity of the tradable sector compared to that of the non-tradable sector. Also, α_{20} in equation (8) is a coefficient indicating the extent to which the TFPs of exiting firms were lower than those of existing firms; if α_{20} is negative, we reject the second hypothesis of this paper and conclude that firms with low TFPs exited. The regression analysis results are summarized in the tables in the Appendix of this paper. In this section, the two main results of this paper are described.

The first main result of this study is that the increase in TFP in the tradable industry compared to that in the non-tradable industry after the 1990s was statistically significant only in the second period of the 2000s. This finding is robust to several econometric specifications, as indicated in the Appendix of this paper. Table 4 summarizes this finding.

At this point, we can assume that trade liberalization affects the tradable industry but does not affect the non-tradable industry, as in Pavcnik (2002). Hence, if the increase in TFP in the tradable industry directly affected by Korean trade liberalization is higher than that in the non-tradable industry, this can be interpreted as a positive effect of trade liberalization, as in Pavcnik (2002). In the second period, which marks the period of recovery from the shock of the Asian financial crisis of 1997, the reduction in tariffs through the FTAs was not significant. However, in the second period, economic growth was recorded at an annual average of 4.5%, and the growth rates of exports and imports exceeded the annual average of 18% due to the influence of China. During this period, with the explosive increases in exports

TABLE 4— CHANGES IN THE TFP OF EXISTING TRADABLE FIRMS COMPARED TO NON-TRADABLE FIRMS IN MODEL 2

(Unit: Natural log)

	Year	Export-driven (α_{31})	Import-competing (α_{32})	Intra-trade (α_{33})
1st period	1992	0.022* (0.013)	-0.036** (0.016)	-0.005 (0.012)
	1993	0.027** (0.013)	-0.092*** (0.016)	0.002 (0.012)
	1994	-0.023* (0.013)	-0.088*** (0.016)	0.002 (0.012)
	1995	-0.064*** (0.013)	-0.039** (0.016)	0.042*** (0.012)
	1996	-0.051*** (0.013)	-0.004 (0.016)	0.062*** (0.012)
	1997	-0.115*** (0.013)	-0.028* (0.016)	0.038*** (0.012)
2nd period	2003	0.015 (0.013)	0.012 (0.019)	0.027*** (0.010)
	2004	0.014 (0.013)	0.059*** (0.019)	0.056*** (0.010)
	2005	0.030** (0.012)	0.078*** (0.019)	0.079*** (0.009)
	2006	0.027** (0.012)	0.044** (0.019)	0.051*** (0.009)
	2007	0.055*** (0.012)	0.070*** (0.019)	0.057*** (0.009)
3rd period	2013	-0.025* (0.013)	-0.014 (0.017)	-0.027** (0.012)
	2014	-0.003 (0.013)	-0.000 (0.017)	-0.011 (0.012)
	2016	0.017 (0.013)	0.017 (0.018)	-0.002 (0.012)
	2017	0.052*** (0.013)	-0.002 (0.018)	0.045*** (0.013)

Note: 1) Figures in the parentheses denote the standard deviation, 2) Statistical significance levels: *** p<0.01, ** p<0.05 and * p<0.1, 3) The numbers of observations for the first, second, and third phases are correspondingly 331,750, 317,936, and 294,997. The respective R-squared values are 0.382, 0.215, and 0.230, 4) The Mining and Manufacturing Survey for 2015 is not included, as it was separated in 2015 with the start of the integrated economic statistics survey.

Source: By the author using Table 2-14~16 from Song (2019).

and imports, the growth of export-led industries, the decline in import-competing industries, and the outward growth stagnation of the import and export industries coexisted.

The analysis results of this study summarized in Table 4 show that in the second period, productivity was increasing in all tradable industries.[6] This result suggests that active efforts were made to increase the productivity of firms in all tradable industries in response to changes in the trade environment, such as the expansions of exports and imports. In particular, despite the fact that the share of the import-

[6]In models 3 and 4, applying a 10% cut off point, the export-led industry TFPs in 2005 and 2006 were found to be negative. However, those values were found to be positive in all other models. See Tables A1-2 and A2-2.

TABLE 5— MAJOR MACROECONOMIC CONDITIONS IN KOREA SINCE THE 1990S

(Unit: %)

	Year	GDP growth	Export growth	Import growth	Average tariff rate
1st period	1991	10.4	10.5	16.7	12.7
	1992	6.2	6.6	0.3	10.8
	1993	6.8	7.3	2.5	9.0
	1994	9.2	16.8	22.1	7.8
	1995	9.6	30.3	32.0	7.7
	1996	7.6	3.7	11.3	7.6
	1997	5.9	5.0	-3.8	7.7
	Annual average growth	7.5	11.2	10.0	-8.1
2nd period	2002	7.4	8.0	7.8	7.1
	2003	2.9	19.3	17.6	6.8
	2004	4.9	31.0	25.5	6.4
	2005	3.9	12.0	16.4	6.3
	2006	5.2	14.4	18.4	6.3
	2007	5.5	14.1	15.3	6.3
	Annual average growth	4.5	18.0	18.6	-2.3
3rd period	2012	2.3	-1.3	-0.9	6.1
	2013	2.9	2.1	-0.8	6.0
	2014	3.3	2.3	1.9	6.0
	2015	2.8	-8.0	-16.9	6.0
	2016	2.9	-5.9	-6.9	6.0
	2017	3.1	15.8	17.8	N/A
	Annual average growth	3.0	0.9	-1.6	-0.3

competing industry showed a downward trend,[7] the productivity increase in the industry was higher than that in the non-tradable industry. This can be interpreted as a result of promoting market competition due to the increase in imports. In other words, firms attempted to increase their own productivity for their own survival.

In the first period, the tariff rate cut was large, but after 1995, except for intra-trade industries, no increase in TFP in the trading industry could be confirmed. Most export-led industries and import-competing industries are light industries, and major heavy and chemical industries such as petrochemicals and semiconductors are classified as intra-trade industries in this period. The 1990s was a time when Korea's industrial structure was transforming from light industry to heavy and chemical industry due to the rise of China. Therefore, it can be interpreted that export-led and import-competing industries, mainly composed of light industrial firms, viewed their future business prospects negatively due to the expansion of Chinese exports to Korea and the world and did not take strong measures to improve their productivity. On the other hand, in the intra-trade industry, mainly heavy and chemical industrial firms, TFP increased after 1995. It can also be interpreted that the positive business

[7]See Table 2-5 in Song (2019), p.35.

outlook in this industry brought about productivity improvement efforts due to the rise of China.

In the third period, TFP increase in the tradable industry was not confirmed in most periods. During this period, although FTAs with major trading partners such as the EU, the United States, and China took effect, the average effective tariff rate was not significantly reduced. This occurred because, due to the nature of the FTA negotiations, the decline in tariff rates for sensitive items that have a large impact on the domestic industry will be implemented in the longer term.[8] As a result, it may be reasonable to interpret that the full effect of signing an FTA with major countries in the third period has not yet been felt. Nevertheless, it raises concern that the effect of increasing TFP in the tradable industry could not be confirmed in the third period. Increasing TFP in the tradable industry is possible when there are active efforts to increase productivity by firms in this industry. In this regard, it is a very worrisome result that we cannot find evidence that firms in tradable industries made active efforts to increase their productivity rates in given situation in which the trade environment was expected to change due to the conclusion of FTAs with major countries.

The second main result of this study is that plants with low TFP exited from the tradable and non-tradable industries and these exits had a positive effect on the productivity improvement in the manufacturing industry. This finding is also robust to several econometric specifications, as indicated in the Appendix of this paper. Table 6 summarizes this finding in this paper.

If trade liberalization intensifies market competition in the domestic market and therefore accelerates the exit of firms with low productivity in import-related industries, this can be interpreted as a positive impact of import liberalization in terms of overall productivity. In general, trade liberalization can lead to an increase in exits by import-competing industries due to increased imports and a decrease in exits by export-led industries due to export expansion. This study did not analyze

TABLE 6— EFFECTS OF AN INCREASE IN TFP DUE TO FIRM EXITS IN MODEL 2

(Unit: Natural log)

	1st period (1991-1997)	2nd period (2002-2007)	3rd period (2012-2017)
Exit (α_{20})	-0.183*** (0.007)	-0.207*** (0.006)	-0.253*** (0.012)
Export-driven industry (α_{21})	0.063*** (0.008)	-0.015 (0.010)	0.039*** (0.013)
Import-competing industry (α_{22})	-0.005 (0.011)	-0.097** (0.015)	0.017 (0.017)
Intra-trade industry (α_{23})	0.045*** (0.008)	0.006 (0.008)	0.032*** (0.013)
Number of observations	331,750	317,936	294,997
R-squared	0.382	0.215	0.230

[8]For industrial products in the Korea-China FTA, tariffs on 59% of items were eliminated immediately after the FTA came into force in December of 2015, and tariffs on 90% of items are phased out within ten years after the FTA came into force. Excluding concessions from industrial products accounted for 2.4% of items. Moreover, 96.1% of tariffs on Korean industrial products, excluding agricultural products and textiles, were phased out within five years in the Korea-US FTA. See explanatory notes on both FTAs by the Korean government (available at https://fta.go.kr/cn/doc/2/ and https://fta.go.kr/webmodule/_PSD_FTA/us/data/13/k_us_12.pdf).

the effect of trade liberalization on exits. However, it was found that firms with low total factor productivity exited from the tradable industry as a whole, with this result showing that these exits had a positive effect on the TFP of the tradable industry. Since the 1990s, the TFPs of firms that exited were 15 to 25% lower than those of surviving firms. In the import-competing industry, the TFPs of firms that exited in the second period were approximately 30% lower than those of the surviving firms. In most models applied in this paper, this effect was slightly lower in export-led industries and intra-trade industries in the first and third periods.

D. *Sensitivity Analysis*

This sector explores the robustness of the findings in this paper. Various specification results of this regression are reported in the Appendix. Table A1 summarizes the regression results with different import/export ratios, while Table A2 summarizes those with different estimation methods. Like Pavcnik (2002), models 1 and 2 applied cut-off points of 15%; for example, firms belong to an industry whose ratio of imports to total domestic output exceeds 15% are characterized as import-competing firms. I also experimented with different cut-off points. The results are robust to definitions based on cut-off points of 10 (models 3 and 4) and 25% (models 5 and 6). The results of the regression analysis after recalculating the capital amount of the firms using the Perpetual Inventory Method and removing outliers with a TFP of 0 or less are presented in Table A2 (models 7 and 8). In addition, the results of a regression analysis of a fixed effects model including the plant fixed effect are also presented in Table A2 (models 9 and 10).

The regression analysis above did not take into account the exchange rate. In general, the movement of the exchange rate affects the profitability of companies in the tradable sector. Therefore, the exchange rate can also affect productivity of the tradable industry. The results of a simple regression analysis of the effect of exchange rates on productivity are shown in Table 7. What can be seen here is that the exchange rate may have some influence on the productivity of non-tradable and intra-trade industries, but it is insignificant such that it has little effect. This means that the exclusion of the exchange rate from my initial analysis is unlikely to affect the robustness of the results of the previous regression analysis.

TABLE 7— RELATIONSHIP BETWEEN PRODUCTIVITY AND EXCHANGE RATES

	Year 1991~97	Year 2002~07	Year 2012~17
Exchange rate	-0.0001*** (0.000)	0.0001*** (0.000)	0.0053*** (0.0010)
Exchange rate *export-led	-0.0002*** (0.000)	-0.0001*** (0.000)	-0.0001*** (0.000)
Exchange rate *import-competing	-0.0002*** (0.000)	-0.0002*** (0.000)	-0.0002*** (0.000)
Exchange rate *intra-trade	-0.0001*** (0.000)	-0.0001*** (0.000)	-0.0001*** (0.000)

Note: 1) Figures in the parentheses denote the standard deviation, 2) Statistical significance levels: *** p<0.01, ** p<0.05 and * p<0.1, 3) Exchange rate data is the yearly average of the KRW/USD exchange rate provided by the Bank of Korea and the economic statistics system (https://ecos.bok.or.kr/, access date: December 18, 2019).

Source: By the author using Table 2-17 from Song (2019).

IV. Conclusion

Since the 1980s, there have been many changes in Korea's trade environment. Diplomatic relations between Korea and China were established in 1992, the WTO Uruguay Round negotiations were concluded in the 1990s, several FTAs were signed in the 2000s and the 2010s, and exports and imports of Korea and other countries around the world increased significantly until the 2010s. The questions here focus on the effect of Korea's trade liberalization policy on firm productivity rates since the 1990s, especially whether it has improved productivity in all industries by enhancing the productivity of existing firms and/or through the exits of low-productivity firms. In order to answer these questions, this study examines how the dynamic process of firm exits affected the productivity of the Korean manufacturing industry and analyzes the changes in productivity rates in the tradable sector compared to those in the non-tradable sector.

There are relatively few studies on Korea's import liberalization policy, despite the fact that the policy overall likely strengthened market competition and, therefore, innovations. In general, because trade liberalization has a variety of effects on the productivity of firms and industries, factors such as the macroeconomic environment - other than trade liberalization – may have also affected the productivity of firms and industries, measuring the effect of trade liberalization on the productivity of Korean manufacturing is not an easy task. Considering this difficulty, this study analyzed the relationship between trade liberalization and manufacturing productivity in Korea using a methodology proposed by Pavcnik (2002).

The main results of this study are as follows. First, it was found that exits had a positive effect by increasing TFP, as plants with low TFP levels exited across industries. This effect was typically significant in the import-competing industry. Second, since the 1990s, the increase in TFP in the tradable industry compared to that in the non-tradable industry was statistically significant only in the second period. The tariff rate cut was largest in the first period, but since 1995, except for the intra-trade industries, no increase in the TFP in the tradable sector compared to the non-tradable sector could be confirmed. This appears to be related to the fact that export-led industries and import-competing industries mainly consist of light industrial firms. Another factor is the rise of China. In other words, because businesses in the export-led industrial and import-competing industrial categories may view their future business prospects negatively due to the rise of China, they did not make much of an effort to improve their productivity rates. It can be said that a positive business outlook brings about productivity improvement efforts.

In the third period, a TFP increase in the tradable sector was not confirmed in most periods. This raises concerns because the third period is when the FTAs with major trading countries such as the EU, the US and China came into effect. This is a very worrisome result of the analysis because it suggests that Korean manufacturing firms in tradable industries did not make active efforts to increase their productivity rates in a situation where changes in the trade environment could be expected due to the conclusion of the FTAs with major countries. However, given that Korea's exports and imports declined across the board in the third period, except for 2017, due to global economic environment at that time, it is too early to conclude that the FTAs

with major countries did not benefit the Korean economy in terms of productivity based on this analysis only.

This study has several limitations. First, this study did not test for a direct causal relationship between trade liberalization and TFP. In addition, any direct link between trade liberalization and firm exits was also excluded from the analysis. The study did not analyze factors that increase TFP in the tradable industry through the introduction of advanced foreign technology and improved access to intermediate goods. Future research on these subjects will be needed.

Although innovative growth is being emphasized to increase the potential growth rate of the Korean economy, there has not been much discussion of the relationship between innovative growth and foreign economic policies. Trade liberalization, the main means of foreign economic policy, creates an environment in which competitive companies can expand through 'economy of scale' effects, but 'strengthening market competition' effects due to the expansion of imports strengthen competition in the market of import-competing industries, leading to the exit of marginal companies. Consequently, it is a double-edged sword. The exit of marginalized companies may cause social problems such as unemployment, but it has positive aspects, such as improving the overall productivity of the industry in the country.

Korea's foreign economic policies, especially import regulation policies such as tariffs, with the main purpose of 'promoting exports and protecting domestic industries', have tended to protect domestic industries. Therefore, it is necessary to review the achievements of Korea's import liberalization policy on domestic industries thoroughly and to consider transforming Korea's foreign economic policy into a competitive foreign economic policy that drives the innovative growth of the Korean economy. The increase in exports pursued by Korea's foreign economic policy thus far has contributed greatly to the growth and expansion of Korean companies due to the 'economy of scale' effect, but it is also true that the benefits have been largely concentrated on some of the largest export companies, which has led to the excessive market influence by these large companies. In addition, the side effects of foreign economic policies that prioritize the protection of domestic industries may be related to the decrease in exits and the decrease in the productivity increase in the overall manufacturing industry in the 2010s.

For active innovation in the Korean manufacturing industry, future foreign economic policies should accept the beneficial effects of exits as well, and change the direction toward minimizing the adverse effects of exits through welfare policies instead of the protection of domestic firms through import barriers. That is, foreign economic policies should be divided into industrial policies aimed at improving productivity and welfare policies aimed at improving the social safety net to mitigate the negative effects of firm exits. In terms of industrial policy, the reduction of import barriers should be designed so that the beneficial effects of firm exits are not impaired by the occurrence of economic rent and moral hazard. At the same time, the welfare policy aspects of foreign economic policies should be supplemented to minimize the adverse effects of exits.

APPENDIX

TABLE A1— REGRESSION RESULTS WITH DIFFERENT IMPORT/EXPORT RATIOS

[1. FIRST PERIOD]

		15%		10%		20%	
		Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
		Coef. (s.e.)	Coef. (s.e.)	Coef. (s.e.)	Coef. (s.e.)	Coef. (s.e.)	Coef. (s.e.)
1st period	ex	-0.111*** (0.011)	-0.122*** (0.011)	0.056*** (0.012)	0.044*** (0.012)	-0.085*** (0.009)	-0.096*** (0.009)
	im	-0.141*** (0.012)	-0.140*** (0.012)	-0.166*** (0.013)	-0.165*** (0.014)	-0.053*** (0.011)	-0.059*** (0.011)
	bi	-0.097*** (0.009)	-0.104*** (0.009)	-0.022** (0.010)	-0.029*** (0.010)	-0.037*** (0.009)	-0.041*** (0.009)
	exit	-0.146*** (0.003)	-0.183*** (0.007)	-0.145*** (0.003)	-0.188*** (0.008)	-0.146*** (0.003)	-0.180*** (0.005)
	exit_ex		0.063*** (0.008)		0.076*** (0.010)		0.065*** (0.007)
	exit_im		-0.005 (0.011)		-0.006 (0.012)		0.045*** (0.010)
	exit_bi		0.045*** (0.008)		0.047*** (0.009)		0.024*** (0.008)
	ex*92	0.022 (0.013)	0.022* (0.013)	-0.003 (0.015)	-0.002 (0.015)	-0.027** (0.011)	-0.027** (0.011)
	ex*93	0.027** (0.013)	0.027** (0.013)	-0.018 (0.015)	-0.019 (0.015)	-0.042*** (0.011)	-0.043*** (0.011)
	ex*94	-0.019 (0.013)	-0.023* (0.013)	-0.056*** (0.015)	-0.061*** (0.015)	-0.052*** (0.011)	-0.056*** (0.011)
	ex*95	-0.062*** (0.013)	-0.064*** (0.013)	-0.036** (0.015)	-0.037** (0.015)	-0.019* (0.011)	-0.021* (0.011)
	ex*96	-0.048*** (0.013)	-0.051*** (0.013)	-0.018 (0.015)	-0.022 (0.015)	-0.032*** (0.011)	-0.035*** (0.011)
	ex*97	-0.112*** (0.013)	-0.115*** (0.013)	-0.110*** (0.015)	-0.114*** (0.015)	-0.085*** (0.011)	-0.089*** (0.011)
	im*92	-0.036** (0.016)	-0.036** (0.016)	-0.029* (0.018)	-0.029 (0.018)	-0.079*** (0.014)	-0.079*** (0.014)
	im*93	-0.092*** (0.016)	-0.092*** (0.016)	-0.068*** (0.017)	-0.068*** (0.017)	-0.147*** (0.014)	-0.148*** (0.014)
	im*94	-0.087*** (0.016)	-0.088*** (0.016)	-0.075*** (0.017)	-0.076*** (0.017)	-0.120*** (0.014)	-0.122*** (0.014)
	im*95	-0.039** (0.016)	-0.039** (0.016)	-0.011 (0.017)	-0.012 (0.017)	-0.035** (0.014)	-0.036*** (0.014)
	im*96	-0.004 (0.016)	-0.004 (0.016)	0.041** (0.017)	0.041** (0.017)	-0.055*** (0.014)	-0.057*** (0.014)
	im*97	-0.029* (0.016)	-0.028* (0.016)	0.006 (0.018)	0.007 (0.018)	-0.097*** (0.014)	-0.100*** (0.014)
	bi*92	-0.005 (0.012)	-0.005 (0.012)	0.013 (0.013)	0.014 (0.013)	-0.019 (0.011)	-0.019 (0.011)
	bi*93	0.002 (0.012)	0.002 (0.012)	0.028** (0.013)	0.027** (0.013)	-0.031*** (0.011)	-0.032*** (0.011)
	bi*94	0.005 (0.012)	0.002 (0.012)	0.017 (0.013)	0.013 (0.013)	-0.028** (0.011)	-0.029*** (0.011)
	bi*95	0.043*** (0.012)	0.042*** (0.012)	0.048*** (0.013)	0.047*** (0.013)	0.031*** (0.011)	0.030*** (0.011)
	bi*96	0.065*** (0.012)	0.062*** (0.012)	0.091*** (0.013)	0.089*** (0.013)	0.030*** (0.011)	0.029*** (0.011)
	bi*97	0.041*** (0.012)	0.038*** (0.012)	0.056*** (0.013)	0.054*** (0.013)	0.016 (0.011)	0.015 (0.011)
	Industry	YES	YES	YES	YES	YES	YES
	Year	YES	YES	YES	YES	YES	YES
	R	0.382	0.382	0.378	0.378	0.378	0.379
	N	331,750	331,750	331,750	331,750	331,750	331,750

TABLE A1— REGRESSION RESULTS WITH DIFFERENT IMPORT/EXPORT RATIOS (CONT'D)

[2. SECOND PERIOD]

		15%		10%		20%	
		Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
		Coef. (s.e.)	Coef. (s.e.)	Coef. (s.e.)	Coef. (s.e.)	Coef. (s.e.)	Coef. (s.e.)
2nd period	ex	-0.109*** (0.009)	-0.107*** (0.010)	0.057*** (0.012)	0.059*** (0.012)	-0.152*** (0.008)	-0.154*** (0.009)
	im	-0.216*** (0.014)	-0.200*** (0.015)	-0.039*** (0.015)	-0.037** (0.015)	-0.132*** (0.011)	-0.120*** (0.011)
	bi	-0.085*** (0.008)	-0.086*** (0.008)	-0.046*** (0.009)	-0.048*** (0.010)	-0.156*** (0.008)	-0.160*** (0.008)
	exit	-0.212*** (0.003)	-0.207*** (0.006)	-0.215*** (0.014)	-0.220*** (0.009)	-0.213*** (0.003)	-0.214*** (0.006)
	exit_ex		-0.015 (0.010)		-0.011 (0.012)		0.014 (0.008)
	exit_im		-0.097*** (0.015)		-0.011 (0.016)		-0.089*** (0.011)
	exit_bi		0.006 (0.008)		0.013 (0.010)		0.026*** (0.008)
	ex*03	0.015 (0.013)	0.015 (0.013)	0.015 (0.014)	0.015 (0.014)	0.010 (0.011)	0.010 (0.011)
	ex*04	0.014 (0.013)	0.014 (0.013)	-0.017 (0.014)	-0.017 (0.014)	0.019* (0.011)	0.019* (0.011)
	ex*05	0.030** (0.012)	0.030** (0.012)	-0.014 (0.014)	-0.013 (0.014)	0.048*** (0.011)	0.048*** (0.011)
	ex*06	0.027** (0.012)	0.027** (0.012)	-0.031** (0.014)	-0.031** (0.014)	0.052*** (0.011)	0.053*** (0.011)
	ex*07	0.056*** (0.012)	0.055*** (0.012)	-0.025* (0.014)	-0.025* (0.021)	0.081*** (0.011)	0.082*** (0.011)
	im*03	0.010 (0.019)	0.012 (0.019)	0.004 (0.021)	0.004 (0.021)	0.017 (0.014)	0.018 (0.014)
	im*04	0.061*** (0.019)	0.059*** (0.019)	0.030 (0.021)	0.029 (0.021)	0.034** (0.014)	0.034** (0.014)
	im*05	0.078*** (0.019)	0.078*** (0.019)	0.047** (0.020)	0.047** (0.021)	0.055*** (0.014)	0.056*** (0.014)
	im*06	0.047*** (0.019)	0.044** (0.019)	0.099*** (0.022)	0.103*** (0.022)	0.012 (0.013)	0.010 (0.013)
	im*07	0.074*** (0.019)	0.070*** (0.019	0.015 (0.000)	0.014 (0.000)	0.037*** (0.013)	0.035*** (0.013)
	bi*03	0.027*** (0.010)	0.027*** (0.010)	0.024* (0.012)	0.000 (0.012)	0.036*** (0.010)	0.036*** (0.010)
	bi*04	0.056*** (0.010)	0.056*** (0.010)	0.022* (0.013)	0.024* (0.013)	0.098*** (0.010)	0.098*** (0.010)
	bi*05	0.079*** (0.009)	0.079*** (0.009)	0.037*** (0.012)	0.022* (0.012)	0.129*** (0.010)	0.129*** (0.010)
	bi*06	0.050*** (0.009)	0.051*** (0.009)	0.006 (0.012)	0.037*** (0.012)	0.130*** (0.010)	0.131*** (0.010)
	bi*07	0.057*** (0.009)	0.057*** (0.009)	-0.002 (0.012)	0.007 (0.012)	0.154*** (0.010)	0.155*** (0.010)
	Industry	YES	YES	YES	YES	YES	YES
	Year	YES	YES	YES	YES	YES	YES
	R	0.215	0.215	0.214	0.214	0.216	0.216
	N	317,936	317,936	317,936	317,936	317,936	317,936

TABLE A1— REGRESSION RESULTS WITH DIFFERENT IMPORT/EXPORT RATIOS (CONT'D)

[3. THIRD PERIOD]

		15%		10%		20%	
		Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
		Coef. (s.e.)	Coef. (s.e.)	Coef. (s.e.)	Coef. (s.e.)	Coef. (s.e.)	Coef. (s.e.)
3rd period	ex	-0.057*** (0.012)	-0.063*** (0.012)	-0.004 (0.013)	-0.006 (0.013)	0.064*** (0.008)	0.070*** (0.008)
	im	-0.189*** (0.014)	-0.191*** (0.015)	-0.059*** (0.016)	-0.065*** (0.016)	-0.114*** (0.013)	-0.112*** (0.013)
	bi	-0.009 (0.010)	-0.015 (0.010)	-0.068*** (0.011)	-0.075*** (0.011)	0.046*** (0.008)	0.047*** (0.008)
	exit	-0.223*** (0.004)	-0.253*** (0.012)	-0.224*** (0.004)	-0.261*** (0.014)	-0.224*** (0.004)	-0.213*** (0.007)
	exit_ex		0.039*** (0.013)		0.019 (0.017)		-0.033 (0.007)
	exit_im		0.017 (0.017)		0.046** (0.018)		-0.017 (0.011)
	exit_bi		0.032** (0.013)		0.046*** (0.015)		-0.006 (0.014)
	ex*13	-0.026** (0.013)	-0.025* (0.013)	-0.064*** (0.016)	-0.063*** (0.016)	-0.034*** (0.011)	-0.035*** (0.011)
	ex*14	-0.006 (0.013)	-0.003 (0.013)	-0.035** (0.016)	-0.033** (0.016)	-0.019* (0.011)	-0.021* (0.011)
	ex*16	0.016 (0.013)	0.017 (0.013)	-0.073*** (0.016)	-0.072*** (0.016)	-0.085*** (0.011)	-0.086*** (0.011)
	ex*17	0.045*** (0.013)	0.052*** (0.013)	-0.026 (0.016)	-0.023 (0.016)	-0.080*** (0.011)	-0.086*** (0.011)
	im*13	-0.015 (0.017)	-0.014 (0.017)	-0.052*** (0.018)	-0.050*** (0.018)	-0.011 (0.015)	-0.011 (0.015)
	im*14	-0.001 (0.018)	-0.000 (0.017)	-0.025 (0.018)	-0.021 (0.018)	-0.009 (0.015)	-0.011 (0.015)
	im*16	0.016 (0.018)	0.017 (0.018)	-0.032* (0.019)	-0.030 (0.019)	-0.042*** (0.015)	-0.043*** (0.015)
	im*17	-0.004 (0.012)	-0.002 (0.018)	-0.018 (0.019)	-0.010 (0.019)	-0.081*** (0.015)	-0.084*** (0.015)
	bi*13	-0.028** (0.012)	-0.027** (0.012)	-0.035*** (0.013)	-0.033*** (0.013)	-0.027*** (0.009)	-0.027*** (0.009)
	bi*14	-0.014 (0.012)	-0.011 (0.012)	-0.011 (0.013)	-0.008 (0.013)	-0.028*** (0.009)	-0.028*** (0.009)
	bi*16	-0.003 (0.012)	-0.002 (0.012)	0.028** (0.013)	0.029** (0.014)	-0.070*** (0.009)	-0.070*** (0.009)
	bi*17	0.040*** (0.012)	0.045*** (0.013)	0.076*** (0.013)	0.083*** (0.013)	-0.034*** (0.009)	-0.035*** (0.009)
	Industry	YES	YES	YES	YES	YES	YES
	Year	YES	YES	YES	YES	YES	YES
	R	0.23	0.23	0.229	0.229	0.230	0.230
	N	294,997	294,997	294,997	294,997	294,997	294,997

Note: 1) Figures in the parentheses denote the standard deviation, 2) Statistical significance levels: *** p<0.01, ** p<0.05 and * p<0.1.

TABLE A2— REGRESSION RESULTS WITH DIFFERENT METHODS

[1. FIRST PERIOD]

		Perpetual Inventory Method		Fixed effect Model	
		Model 7	Model 8	Model 9	Model 10
		Coef. (s.e.)	Coef. (s.e.)	Coef. (s.e.)	Coef. (s.e.)
1st period	ex	-0.117*** (0.010)	-0.127*** (0.010)	0.004 (0.013)	0.006 (0.013)
	im	-0.141*** (0.012)	-0.138*** (0.012)	0.023 (0.015)	0.022 (0.015)
	bi	-0.111** (0.009)	-0.117*** (0.009)	-0.041*** (0.010)	-0.040*** (0.010)
	exit	-0.154*** (0.003)	-0.186*** (0.006)	0.009*** (0.003)	-0.001 (0.007)
	exit_ex		0.063*** (0.008)		0.015* (0.009)
	exit_im		-0.020* (0.010)		-0.005 (0.012)
	exit_bi		0.037*** (0.007)		0.013 (0.008)
	ex*92	0.022* (0.013)	0.022* (0.013)	0.035*** (0.010)	0.033*** (0.010)
	ex*93	0.041*** (0.012)	0.040*** (0.012)	0.047*** (0.010)	0.045*** (0.010)
	ex*94	-0.010 (0.012)	-0.014 (0.012)	0.014 (0.010)	0.010 (0.011)
	ex*95	-0.059*** (0.012)	-0.060*** (0.012)	-0.016 (0.011)	-0.020* (0.011)
	ex*96	-0.052*** (0.012)	-0.055*** (0.013)	0.003 (0.011)	-0.020* (0.011)
	ex*97	-0.114*** (0.013)	-0.118*** (0.015)	-0.063*** (0.011)	-0.069*** (0.012)
	im*92	-0.028* (0.015)	-0.028* (0.015)	-0.033*** (0.012)	-0.032*** (0.012)
	im*93	-0.095*** (0.015)	-0.095*** (0.015)	-0.084*** (0.013)	-0.084*** (0.013)
	im*94	-0.077*** (0.015)	-0.077*** (0.015)	-0.068*** (0.013)	-0.067*** (0.013)
	im*95	-0.035** (0.015)	-0.035** (0.015)	-0.017 (0.013)	-0.016 (0.013)
	im*96	-0.015 (0.015)	-0.014 (0.015)	0.010 (0.013)	0.012 (0.014)
	im*97	-0.035** (0.016)	-0.034** (0.016)	-0.038*** (0.014)	-0.036** (0.015)
	bi*92	0.001 (0.012)	0.001 (0.012)	0.002 (0.009)	0.001 (0.009)
	bi*93	0.007 (0.011)	0.006 (0.011)	0.009 (0.009)	0.007 (0.009)
	bi*94	0.012 (0.011)	0.009 (0.011)	0.013 (0.009)	0.010 (0.010)
	bi*95	0.047*** (0.011)	0.046*** (0.011)	0.060*** (0.010)	0.056*** (0.010)
	bi*96	0.062*** (0.011)	0.059*** (0.011)	0.065*** (0.010)	0.061*** (0.010)
	bi*97	0.045*** (0.011)	0.042*** (0.011)	0.035*** (0.010)	0.030*** (0.011)
	Industry	YES	YES	YES	YES
	Year	YES	YES	YES	YES
	R	0.421	0.421	0.243	0.243
	N	310,900	310,900	108,310	108,310

TABLE A2— REGRESSION RESULTS WITH DIFFERENT METHODS (CONT'D)

[2. SECOND PERIOD]

		Perpetual Inventory Method		Fixed effect Model	
		Model 7	Model 8	Model 9	Model 10
		Coef. (s.e.)	Coef. (s.e.)	Coef. (s.e.)	Coef. (s.e.)
2nd period	ex	-0.106*** (0.009)	-0.103*** (0.009)	-0.027** (0.013)	-0.028** (0.013)
	im	-0.202*** (0.014)	-0.183*** (0.014)	0.036 (0.027)	0.035 (0.027)
	bi	-0.102*** (0.008)	-0.105*** (0.008)	-0.029** (0.013)	-0.029** (0.013)
	exit	-0.179*** (0.003)	-0.179*** (0.006)	-0.016*** (0.003)	-0.012** (0.006)
	exit_ex		-0.016* (0.010)		-0.015 (0.010)
	exit_im		-0.110*** (0.014)		-0.010 (0.016)
	exit_bi		0.019*** (0.007)		-0.001 (0.008)
	ex*03	0.002 (0.012)	0.002 (0.012)	0.013 (0.009)	0.015 (0.009)
	ex*04	0.004 (0.012)	0.004 (0.012)	0.020** (0.009)	0.022** (0.009)
	ex*05	0.012 (0.012)	0.012 (0.012)	0.021** (0.009)	0.024** (0.009)
	ex*06	0.023* (0.012)	0.022* (0.012)	0.024*** (0.009)	0.028** (0.010)
	ex*07	0.054*** (0.012)	0.053*** (0.012)	0.043*** (0.010)	0.047*** (0.010)
	im*03	0.001 (0.018)	0.003 (0.018)	-0.020 (0.013)	-0.018 (0.014)
	im*04	0.051*** (0.019)	0.049*** (0.019)	0.016 (0.014)	0.017 (0.014)
	im*05	0.058*** (0.018)	0.058*** (0.018)	0.038*** (0.014)	0.040*** (0.015)
	im*06	0.042** (0.018)	0.039*** (0.018)	0.017 (0.014)	0.020 (0.015)
	im*07	0.068*** (0.018)	0.063*** (0.009)	0.027* (0.015)	0.030* (0.015)
	bi*03	0.025*** (0.009)	0.025*** (0.009)	0.017** (0.007)	0.017** (0.007)
	bi*04	0.061*** (0.009)	0.061*** (0.009)	0.041*** (0.007)	0.041*** (0.007)
	bi*05	0.085*** (0.009)	0.085*** (0.009)	0.046*** (0.007)	0.046*** (0.007)
	bi*06	0.069*** (0.009)	0.070*** (0.009)	0.030*** (0.007)	0.031*** (0.007)
	bi*07	0.077*** (0.009)	0.077*** (0.009)	0.021*** (0.007)	0.021*** (0.008)
	Industry	YES	YES	YES	YES
	Year	YES	YES	YES	YES
	R	0.352	0.353	0.042	0.042
	N	308,808	308,808	99,779	99,779

TABLE A2— REGRESSION RESULTS WITH DIFFERENT METHODS (CONT'D)

[3. THIRD PERIOD]

		Perpetual Inventory Method		Fixed effect Model	
		Model 7	Model 8	Model 9	Model 10
		Coef. (s.e.)	Coef. (s.e.)	Coef. (s.e.)	Coef. (s.e.)
3rd period	ex	-0.037*** (0.012)	-0.045*** (0.012)	-0.025 (0.020)	-0.023 (0.020)
	im	-0.179*** (0.014)	-0.185*** (0.014)	0.034 (0.027)	0.034 (0.027)
	bi	-0.011 (0.010)	-0.015 (0.010)	0.001 (0.016)	0.001 (0.016)
	exit	-0.160*** (0.004)	-0.194*** (0.012)	-0.040*** (0.005)	-0.060*** (0.014)
	exit_ex		0.049*** (0.014)		0.040** (0.016)
	exit_im		0.039** (0.018)		0.014 (0.021)
	exit_bi		0.028** (0.013)		0.010 (0.016)
	ex*13	-0.029** (0.012)	-0.027 (0.012)	-0.015* (0.009)	-0.018** (0.009)
	ex*14	-0.021* (0.012)	-0.017 (0.012)	-0.001 (0.009)	-0.005 (0.009)
	ex*16	0.003 (0.013)	0.005 (0.013)	0.030*** (0.009)	0.023** (0.009)
	ex*17	0.028** (0.013)	0.035*** (0.017)	0.053*** (0.009)	0.049*** (0.009)
	im*13	-0.009 (0.013)	-0.008 (0.017)	0.003 (0.012)	0.002 (0.012)
	im*14	-0.023 (0.017)	-0.020 (0.018)	0.009 (0.012)	0.008 (0.012)
	im*16	0.006 (0.017)	0.008 (0.018)	0.055*** (0.013)	0.053*** (0.013)
	im*17	0.011 (0.018)	0.017 (0.018)	0.056*** (0.013)	0.055*** (0.013)
	bi*13	-0.035*** (0.018)	-0.034*** (0.012)	-0.028*** (0.008)	-0.029*** (0.008)
	bi*14	-0.019 (0.012)	-0.016 (0.012)	-0.020** (0.009)	-0.021** (0.009)
	bi*16	-0.003 (0.012)	-0.001 (0.012)	-0.001 (0.009)	-0.003 (0.009)
	bi*17	0.039*** (0.012)	0.044*** (0.012)	0.033*** (0.009)	0.032*** (0.009)
	Industry	YES	YES	YES	YES
	Year	YES	YES	YES	YES
	R	0.349	0.349	0.061	0.061
	N	270,010	270,010	100,056	100,056

Note: 1) Figures in the parentheses denote the standard deviation, 2) Statistical significance levels: *** p<0.01, ** p<0.05 and * p<0.1.

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